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CASEBOOK

OF

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SHEP'S PHOTOSHOP

NSF-HARVARD BLACK HOLE PHOTO FRAUD

The M87 Black Hole photo was unveiled by NSF amid worldwide media blitz on 10 April 2019. The photo was a consummate fraud. After I explained the instrumental fraud, the United States Congress felicitated NSF Director France Córdova and Harvard astronomer Shep Doeleman in a full committee hearing on 16 May 2019. The next day Córdova gave Doeleman a big NSF award and said: "This is why NSF exists."

EXECUTIVE SUMMARY

The Event Horizon Telescope (EHT) Project employs well-known scientific principles, established observational techniques and tried-and-true data reduction algorithms. Much has been made of these methodologies in the media following the announcement of the discovery. This was a well-orchestrated red herring. For these subjects are not in question, and their correctness is irrelevant to the EHT fault.

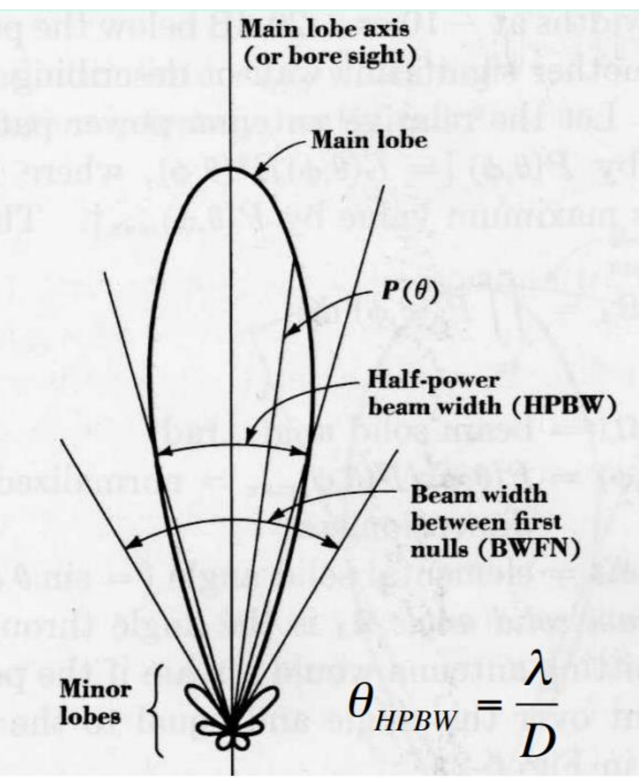
What the world has not been told by anyone is that EHT does not meet the necessary criteria for application of these methodologies. It is basically like doing a great deal of formally correct statistical analysis with nine data points, and then touting how great statistics is. The EHT discovery is laughable at first. But then it is something blacker than the black hole it seeks to image.

2 June 2019

SIMPLIFIED ESSENTIAL CONCEPTS

Radio Telescope: A radio telescope is most commonly a steerable parabolic reflector. It is characterized primarily by its frequency, antenna pattern, and beamwidth.

Beamwidth: The beamwidth of a radio telescope refers to the narrowness of its main beam, and is the measure of how well it can resolve an image on the sky. There are different definitions of beamwidths which are more or less similar. Here are the definitions of HPBW and BWFN:



For our purpose, the beamwidth is the resolution: It is the size of a pixel in an image field mapped by the telescope.

Radio interferometry: When the power received by two separate (and generally identical) telescopes are combined with some phase relationship, the resultant beam of the joint system can be far narrower than that of the individual telescope. The straight-line distance between the two telescopes is the baseline.

Convolution, deconvolution: When a telescope beam sweeps across a distended source on the sky with intensity variations in it, the resultant wiggle is the combined effect of the source variation and the telescope beam pattern. This combining is called convolution. Since the telescope beam pattern is known, the source variation can be backed out from the observed wiggle. This process is called deconvolution.

Interferometric imaging: Since an interferometer provides a sharp beam, it is convenient to use this technique for imaging a distended source that is structured. Sweeps are made in many orientations and with different baselines. All these resultant wiggles can be processed together to reveal the source structure. The resolution of the resulting image can be greater than the interferometer beamwidth. However, this extra resolution does not come from the computer. It is already in the acquired data, but needs to be teased out.

Precondition for interferometric imaging: Interferometric imaging relies on both local intensities and their global association. This means that for a given point on the image field, the analysis includes local data as well as data from the surrounding locations. Thus, the image field must contain a very large number of interferometer beams. Also, the field must have enough structure to it to be amenable to this technique – structures whose coherence length is much larger than the beamwidth.

THE CASE OF EHT

This is a pedagogic cartoon figure I have made to explain the black hole photo. It will be clear from the following diagram how I arrived at this. This figure represents the entire field of the orange-colored black hole image the world saw, leaving out the large black skirt of undefined extent around this orange field. In the above field, the Event Horizon Telescope could give you nine pixels at most. Each pixel corresponds to the size of the EHT beam cross-section (which is actually circular to oval). In each pixel, the EHT gives you one number for the intensity. You can represent these numbers in greyscale. However, because each number has a large error bar, any coherence between adjacent pixel is washed out.

First, consider the global influence. The area outside of this field is uniformly black, without any features (structures) in

it. So, given the imaging technique I explained, where is the greater resolution going to come from? There is no global structural information, nothing at all that can guide the observed image field of nine noisy pixels towards the higher-level interferometric resolution.

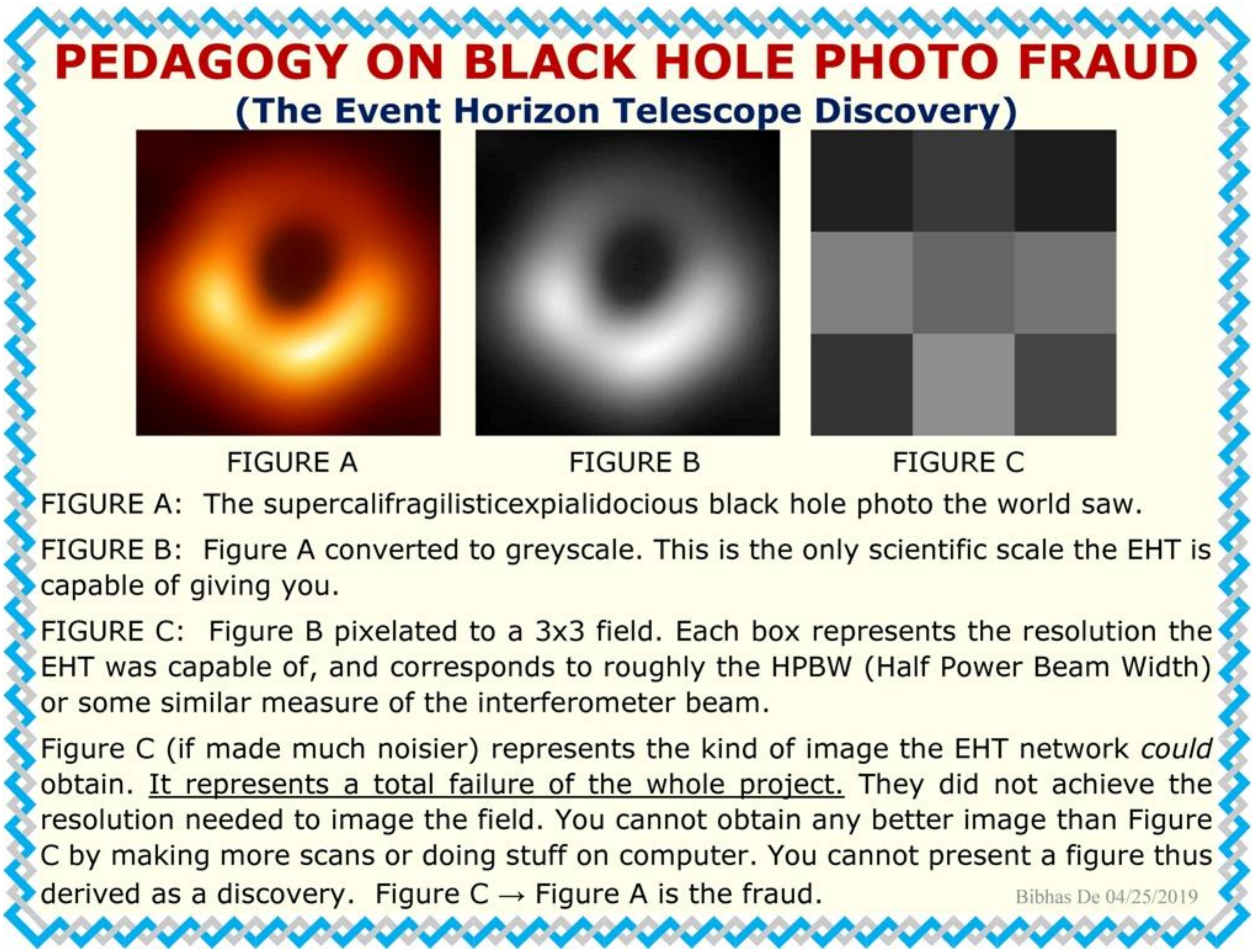
Next consider just the nine-pixel field in and of itself. If you shift your pixel mosaic around on this field (interferometry sweeps essentially do this for you), you will get different pictures like the above one, with different arrangements of the lighter and darker tiles. You may collect a large number of these mosaics, each with nine pixels. Now, can you find a unique underlying intensity map that will produce all these mosaics? Not with nine pixels.

The EHT case does not satisfy the minimum condition necessary for enhancing the resolution with the interferometric mapping technique. EHT gathers no information from the sky from which higher resolution can be teased out.

The EHT resolution is the interferometric beamwidth, period. Anything else that is being said is fraud.

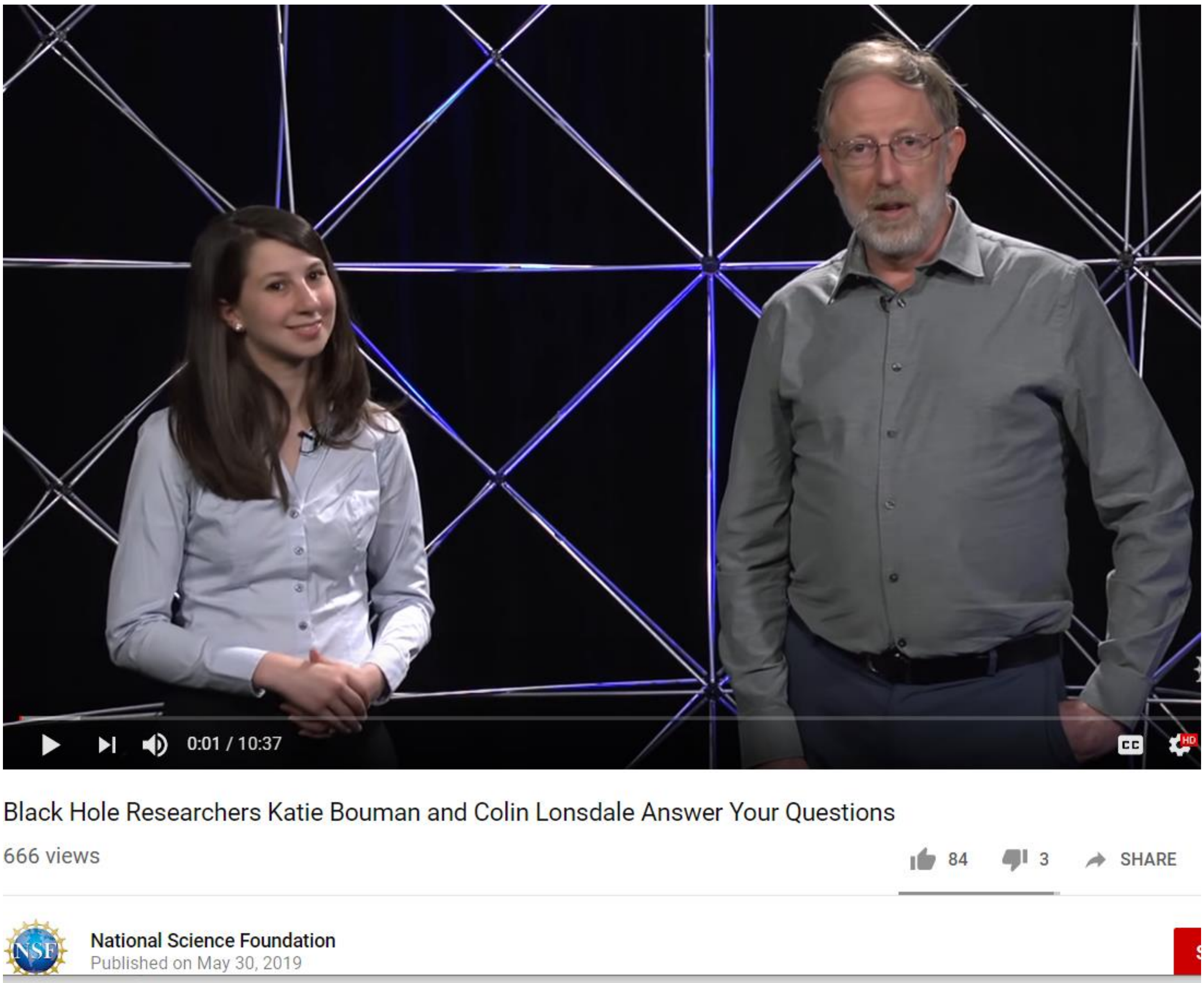
EHT DISCOVERY FOR NON-SCIENTISTS

This is a self-contained graphic that is all you need to understand the fraud which is quite transparent:



NUMBER OF PIXELS: EHT CLAIM

In a very recent National Science Foundation video:



the EHT camp has claimed that their black hole image has 100x100 pixels in it! Extra resolution is coming out the wazoo, but where is it coming from? How does an initial observational resolution of a handful of beamwidths covering the image field go into the computer and return 10,000 pixels worth of crisp, clear discovery image?

DO NOT GET BOGGED DOWN!

Folks, think rational, think physics, think common sense. Don’t get bogged down in Fourier Transform, (u,v) field, interferometric fringes and stuff. They are great, but they have no bearing on EHT.